THE AUDIO LEAGUE REPORT

PLEASANTVILLE, N. Y. DECEMBER 1954 Vol. 1 No. 3 Price 35¢

EQUALIZATION

In testing and evaluating equalizers and control units, the Audio League is confronted with the task of establishing a valid standard for accurate tests. This task is complicated by the fact that there is a great variety of professional opinion concerning the subject of corrective equalization and tone control. For the benefit of our readers, we will attempt, here, to clarify one or two points about the technical aspects of the subject.

Strictly speaking, all types of tone modification may be classed as corrective equalization, provided the purpose is to make the sound picked up by the ear resemble accurately the original sound at "the best seat in the house" where the listener would like to imagine himself seated. By inference then, the term Corrective Equalization means that something has been done to alter the audible characteristics of this sound in the process of transporting it from the place of its creation to the listener's ears. Alterations do, in fact, occur at various stages in the process, making corrective equalization necessary at some point. They are caused by:

(1) effects of accoustic properties of the recording studio;
(2) characteristics of the microphones used;
(3) microphone placement and balance;
(4) record and playback characteristics of the tape recorders used to make the master recording;
(5) recording characteristic used in the disc recorder;
(6) changes occurring in the process of producing pressings from a succession of masters, mothers and stampers;
(7) characteristics of the pickup, playback equalizer, and amplifier circuits used in the home music system;
(8) peculiarities of the loudspeakers or headphones used by the listener;
(9) effects of listening room accoustics;
(10) individual characteristics of hearing.

With the possible exception of the amplifying equipment, none of the above ever fail to alter the program material in some significant way. Great improvements have been made recently in flattening the frequency response of microphones and pickups, but loudspeakers are still notorious for the peaks and dips they put in a response curve. As for the human ear, its non-linearities in frequency response at different intensities are well known and must be taken into account, particularly when we attempt to reproduce the original sound at different intensities.

Cutting the master disc recording requires special alteration of the frequency spectrum so that the amplitude of the groove modulation will not be too large at low frequencies nor too small at high frequencies. Naturally, when the record is played back, an exactly opposite alteration must be achieved to restore the balance between lows and highs. This restoring action is generally called record equalization. More about this later.

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The remaining factors listed above can be compensated for to some degree by the listener if his equipment has flexible controls. The types of controls most common to home music systems are bass and treble tone controls, volume and/or loudness controls, and low-pass and high-pass cutoff filters.

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We are planning a series of discussions on the aspects of equalization as set forth in this introduction. The differences in opinions that prevail on some of these items will also be brought forth. Loudness controls are a typical subject. Here there are many involved factors. We hope not only to point them out to all of our readers but find explanations that you can understand.

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How Loud is a Watt?

Our tests of the air coupler, reported elsewhere in this issue, revealed what we called "fantastically low efficiency". A little elaboration is in order here.

All loudspeakers are quite inefficient in converting electrical energy to accoustic energy. The Klipschorn, the most efficient home reproducer we know of, is only about 50% efficient; a high quality 15" speaker in an ordinary baffle may be approximately 10% efficient. Ordinary speakers may be from 2% to 5% efficient. Our admittedly crude measurements on the air coupler, when correlated with other tests we have made on a really high quality 3-way system, indicate that the air coupler efficiency at 100 cycles is less than 0.1%. A six watt input to the air coupler produces the same sound level at a 6 foot distance that is produced by 0.03 watts input to our comparison system under similar conditions. The comparison system was a slightly modified Klipsch Rebel with an Electrovoice 15 W woofer, which we understand is about 10% efficient.

Please understand that all the figures we have quoted are approximate and merely illustrate orders of magnitude. We do not have the facilities for measuring loudspeaker conversion efficiencies.

Let us consider our Klipsch Rebel system just referred to. A 30 milliwatt input produced a 90 db sound level from this system (at low freqencies, but it is a smooth system and this level is probably applicable throughout the audible range). Few of us can tolerate a 90 db sound level in our living rooms---70 db is more usual.

This leads us naturally to consideration of amplifier power requirements. For the speaker system just described, 0.3 milliwatts would produce a comfortable living room level of 70 db. If we allow 20 db more to accommodate transients, we require an amplifier power output of 30 milliwatts! If we allow for playing at an average level of 90 db, with peaks of

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HOW LOUD IS A WATT cont. from pg. 1.
110 db, 3 watts are called for. A less efficient speaker might require 6 watts, and an excessively "dead" room 12 watts of electrical power (on peaks, which can be handled by a six watt amplifier!

Our conclusion, therefore, is that for home music listening, a 10 to 15 watt amplifier should be more than ample under any conditions we can imagine. A more powerful amplifier can only be justified if the room is unusually large, or has unusually high sound absorption in walls, rugs, etc., and if the listner habitually plays music at levels approaching those of a symphony orchestra "in the flesh". Unquestionably this is the way to listen to music, if you can get away with it! Unfortunately, we can't!

Don't forget, though -- a 50 watt amplifier connected to a speaker rated for 10 or 20 watts is an unhealthy combination. Speakers are easily destroyed by high amplitude bursts such as may occur if a faulty input connection comes loose with the amplifier turned on. Be sure your speaker is rated for the full output of your amplifier.

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Sorry We're Late....

You have possibly noticed that we are a little late in getting out this issue! We're sorry about the delay, but we find ourselves buried under a mass of details involving finances, maintaining subscription records, handling correspondence, etc., that have seriously interfered with the business of testing and writing reports.

We are a very small group--you could count us on the fingers of your hands with no trouble at all--and the Audio League unfortunately can not be our means of livelihood at the present time. So, like most others, we work a regular forty plus hour week--and then Audio becomes our avocation on almost a full-time basis--occupying almost all of our lunch hours, evenings and weekends.

Not one of us has received a cent of remuneration for the hours of work we have put in. We enjoy our Audio League activity and sincerely wish to help others to find their way through the maze that hi-fi has become, even if we never make a nickel (although we would have no objections to the Audio League becoming a paying proposition!)

The difficulty is that, despite our statement in the first issue that we cannot give personal consultation, many of our readers have written to us seeking answers to their hi-fi problems. Some have enclosed stamped, self-addressed envelopes, in accordance with our request others have not. Those of you who have written such letters have noticed that we are not exactly prompt in answering. In fact, we have dozens of letters on hand, some of them three months old. On the other hand, those who have received answers will appreciate the amount of time and thought that went into the preparation of our replies.

It takes the writer an average of one hour per letter to study the problem offered, come up with an answer if possible, and type a reply. In trying to catch up with just the ones who enclosed reply envelopes, we have had to let preparation of the Report fall behind. We don't like that-- neither, presumably, do any of you, our readers, even if your reply is causing the delay.

Here, therefore, is our policy on technical questions from readers-- and we must be quite inflexible in our attitude toward this matter:

After January 1,1955, no free personal answers to your hi-fi problems will be given. If the questions you have are of sufficiently general interest, we will plan to cover them in subsequent issues wherever practical.

We realize that some of you have genuine problems that could be answered in reasonably definite terms. We propose this: For a basic fee of $5.00, payable in advance, we will undertake to give your questions our fullest attention and supply the best answers we know how to give. If it appears that an unusually large amount of time is required to answer a letter, we will so notify you, stating what our fee will be. If we find that your question is unanswerable for any reason, your payment will be returned.. If you are dissatisfied with our answers your payment will likewise be returned.

Frankly, we are not looking for a large consultation business, bedause we spend so much time in supplying answers to your questions that even a $5.00 fee is purely nominal. We would like to devote all the time we can to producing the Report. Please help us to get the job done by not burdening us with your personal questions.

Of course, we would like to receive your comments and criticisms, not only of the Report but of the various pieces of equipment you own. We have received much valuable information from our readers already, which will be incorporated in future reports. Please excuse us, though if we don't acknowledge your letters. We really do appreciate them and occasionally print excerpts from them.

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Audio League Tuner Testing Procedure

For the time being , at least, we are restricting our laboratory tests to FM tuners. While there are indeed substantial differences between various AM tuners, we feel that the best of them are below minimum hi-fi standards. We will therefore give our impression of their performance, omitting quantitative data.

We test FM tuner sensitivity in accordance with IRE standard methods. That is, a calibrated signal generator (Measurements Corp. Model 80) is used to supply the RF signal through a resistance network which not only correctly terminates the signal generator but presents a 300 ohm source impedance to the receiver (on 300 ohm antenna terminals). This, for various reasons beyond the scope of this discussion, is the correct method of simulating the performance of the receiver when connected to a 300 ohm antenna feeder, with the antenna picking up a broadcast signal.

Unfortunately for some receiver manufacturers' advertising departments, this has the effect of applying only half of the signal generator output to the receiver antenna terminals. A common technique of sensitivity measurements consists of applying the generator output directly to the receiver, in which case the receiver may "see" only 25 ohms source impedance instead of the proper 300 ohms. Under these conditions, obviously, fewer microvolts of signal will be needed to produce a given amount of quieting, thereby giving an apparently higher sensitivity figure. This type of measurement is often referred to as using "soft" microvolts, whereas the correct method employs "hard" microvolts.

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A WORD ON AUDIO LEAGUE TESTING POLICY.

We have received numerous requests for tests on speakers, pickup, and turntables, with several readers suggesting the exclusion of tests on amplifiers and tuners.

We do not feel that the hi-fi field is as one-sided as all that - there are plenty of major differences in performance of FM tuners, for example, which the hobbyist is not in a position to evaluate.

Pickup cartridges and arms are on the agenda for early publication. Please realize, however, that we can't test each and every new product as it appears on the market. Time and money considerations aside, we usually get our equipment for testing from distributors, and on a "hot" item such as the National "Criterion", each dealer may have only one demonstrator and we have to wait until the manufacturer can deliver in quantity. Similarly, we would like to test a Leak magnetic pickup, as one reader has requested, but just try to get one!

Speaker testing is the most difficult and controversial subject imagineable, (not that we evade controversial subjects). The difficulty, as we see it, is twofold. (1) No two test set-ups will give the same response curve on the same speaker system, and (2) There is virtually no correlation between response curves and the subjective performance of a speaker system. To be sure, a unit with extreme unevenness of response will usually sound pretty bad, but the converse is not true. There are numerous systems which give reasonably similar, smooth responses, yet they all sound different and will not, in general, meet with unanimous approval by listeners.

We are tackling the problem as follows: In order to get the most repeatable response data (not necessarily the "absolutely accurate" response, if such a thing exists), we have arranged for the use of the finest in automatic frequency response plotting equipment, manufactured by Bruel and Kjaer in Denmark. All tests will be made out-of-doors, in as nearly "free-field" conditions as we can find. In order to minimize ambiguities, we propose to test only complete speaker systems and rate them as such. Whenever an individual speaker is tested, it will be in an enclosure of the manufacturer's own design or recommendation.

Furthermore, and in our opinion more significant than the response curves, we will report on our personal, subjective opinions of how the speaker actually sounds. You will just have to take our word for it that our judgment is based on years of experience and that our opinions will generally be consistent with those held by other experienced and competent audiophiles.

The subject of turntables is another thorny one. Many claims as to low noise and rumble are made, with a complete lack of information on measuring techniques or definitions of terms. One manufacturer's "-60db noise level" may be a far cry from another manufacturer's identical claim. Many, with considerable justification, simply do not quote figures.

We will establish our own standard measuring technique, and describe it in detail in a future issue. All the turntables we will test will be handled and mounted in the same way, if at all possible, so that our figures will serve as a basis of comparison if not as absolute standards.

Please be patient, though. We are just embarking on our expanded testing program, and our personnel and resources are severely overworked. It will undoubtedly be several months before we can present you with complete speaker test data, and almost as long for the results of turntable tests. Bear with us, remembering that the service we hope to render has not been successfully attempted by anyone heretofore. We're going to do our best to make a go of it.

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Test Results vs. Manufacturer's Claims

We prefer to obtain from regular distribution channels such as distributors or audio houses all of the high-fidelity components which we test. When components are so new as to be unobtainable through such channels and we believe that your interest is sufficiently great, we contact the manufacturer and request him to supply us with a unit, either directly or preferably through a distributor. When the manufacturer sends us the units directly, our report will state this fact. This is an attempt to try to obtain only the quality of product obtainable by anyone and not a specially selected unit. However we do recognize that occassionally (even among the very best manufactureres) quality control or incoming components inspection, or final test does slip up and an inferior product reaches the market. Our tests therefore may be on such a rare and peculiar unit, in which case we notify the manufacturer, in advance of our report, that our tests show certain of his claims are unjustified. If he believes his advertizing claims are honest and representative of his product and that we just happen to have obtained a "lemon", he is requested to supply us with additional units of the questionable product for our further testing. Our report is then written and the evidence is based on the tests of several units. If we do not hear from the manufacturer within a reasonable time we assume that he agrees with our findings. If the manufacturer merely answers our letter but does not assist us in evaluating his product, we will print his letter (or salient portions thereof) in the same issue as our report on the product. Occasionally we will make preliminary comments on equipment prior to our final report. This is done when we find our tests indicate wide discrepancies between claims and facts and the particular equipment appears to be an item in great current demand. This is done as a warning, since often the purchaser would be wiser to hold off for a month or two and really know if he is buying what is being offered. In case the product actually turns out to be satisfactory we will boldly and forcefully convey this fact to our readers.

The testing policy outlined above is being put into effect starting with the January issue. Our earlier reports were not called to the attention of the manufacturers in advance of publication, though we have few, if any, reservations about the general validity of our conclusions on any of the items reported on.

Thanks and Praise

"What a pleasant surprise...I do not want to miss a single issue...In the meantime, I have nothing but the most enthusiastic praise for the first issue. The type is small, but that way you can cram more information per page... ..let me express my gratitude to you people who must work so hard for no money or less!..."

Gonzalo Segura, New York City

HEATHKIT W4M WILLIAMSON AMPLIFIER.

The Heath Company has, for some time, been selling Williamson amplifier kits for $49.75, with a choice of a Peerless 20-20 or an Acro Ultra-Linear output transformer. These units, built on two chassis, adhered closely to the Williamson specifications. (See The Audio League Report, Vol. 1, No. 1). There appeared to be little to choose from between the two output transformers, 'though of course the Acro yielded greater power output. However, there was usually a delay of several weeks in getting delivery if the Acro was specified, whereas Peerless transformers were apparently more plentiful. At this modest price, these were unquestionably a best buy in power amplifiers.

Now a still lower-priced model, the W4M, is available, on a single chassis, with a Chicago BO-13 output transformer. Price - $39.75. Frankly, we don't see how they do it, especially since the transformer alone usually sells for about $18.00. Circuit-wise, no changes have been made.

This is very simple to wire, compared to the WA-P2 preamplifier. No one should experience any difficulty in making it perform after 3 or 4 hours work.

The Audio League tested two W4M amplifiers, built by two of the people who constructed the preamplifiers. Neither constructor experienced any difficulty, and both units worked perfectly upon completion.

Fig. 1 shows the frequency and power response of one of the amplifiers. 0 db on the power curve is 9.7 watts; on the frequency response curve, 0 db is 0.5 watts. The other amplifier was quite similar, merely differing in the number and location of wriggles in the high frequency response above 20 kc. Also, its power output was about twice as high as the first, possibly due to somewhat higher plate voltage and "hotter" 5881 output tubes.

While its response curves are not as impressive as those of many other amplifiers outside the 20-20000 cycle limits, they are fully up to Williamson standards within the audible spectrum. The Intermodulation Distortion curves in Fig. 2 show that the W4M takes second place to none in the matter of low distortion. Both units stayed well below 0.1% IM distortion at levels below 7 watts, which is certainly an insignificant amount.

When the amplifiers were first turned on, hum levels were disappointingly high. Further investigation showed that the heaters were ungrounded, presumably because this is taken care of by the hum-bucking potentiometer in the companion preamplifier. By grounding one side of the heater in the power amplifier, a hum level of 76 db below 10 watts was obtained with the input to the amplifier open. Shorting the input increased the hum to -71.5 db. The second amplifier was quite similar; yielding hum levels of -74 db and -65 db respectively for the open and shorted conditions.

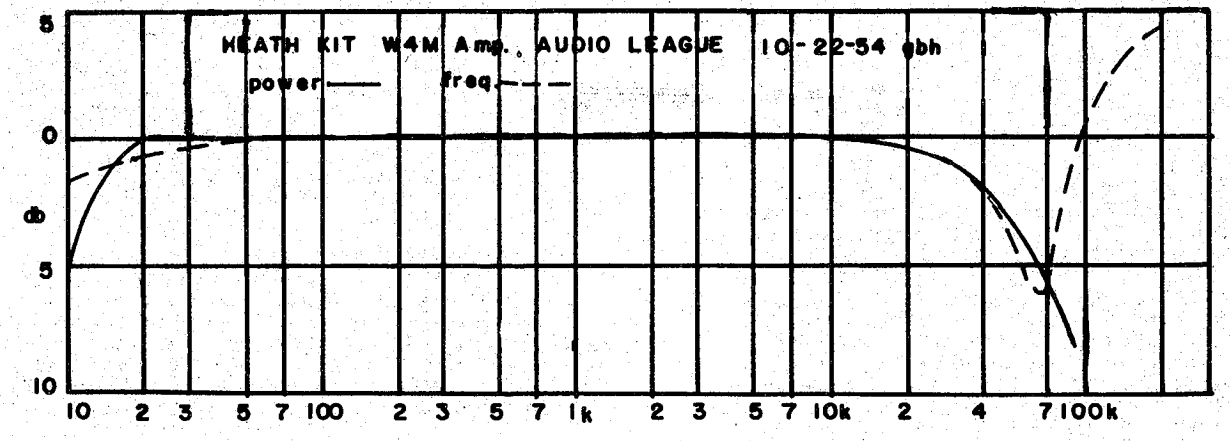
While these hum levels cannot be compared to those of the Craftsmen C500 or Fisher 70A, for example, we feel they are acceptable in home music systems. A preamplifier such as the Heathkit WA-P2, and most lower-priced manufactured units, have hum levels considerably greater than these power amplifiers, and the overall system hum should not be audible under ordinary home listening conditions. Naturally, use of a highly efficient speaker system, such as the Klipschorn may result in a slight hum being audible during quiet interludes. Our experience indicates, however, that a little care in lead dress and a good external ground on the amplifier chassis will enable the constructor to reduce his hum level to at least -74 db which is virtually inaudible.

The stability of the W4M with capacitive loads is quite satisfactory. At least 0.0033 microfarads shunting an 8-ohm resistive load was needed to cause oscillation on one unit, and even 1 microfarad failed to cause trouble on the other. This is sufficiently high so that it would never be encountered in practise.

Both amplifiers required 1.2 volts RMS to drive them to full output.

The amplifiers are constructed, complete with power supply, on a gray hammertone finished chassis 15-3/4" wide by 10-3/4" deep by 7" high (including 1-1/2" depth needed for the preamplifier power plug). It is quite heavy, and the chassis is rather light, but since it is not designed for rough handling, we do not object to this.

To summarize, The Audio League finds that the Heathkit W4M Williamson amplifier is an excellent unit of unusually low distortion, adequate frequency range and power-handling capacity, which can match or better the performance of almost any amplifier we



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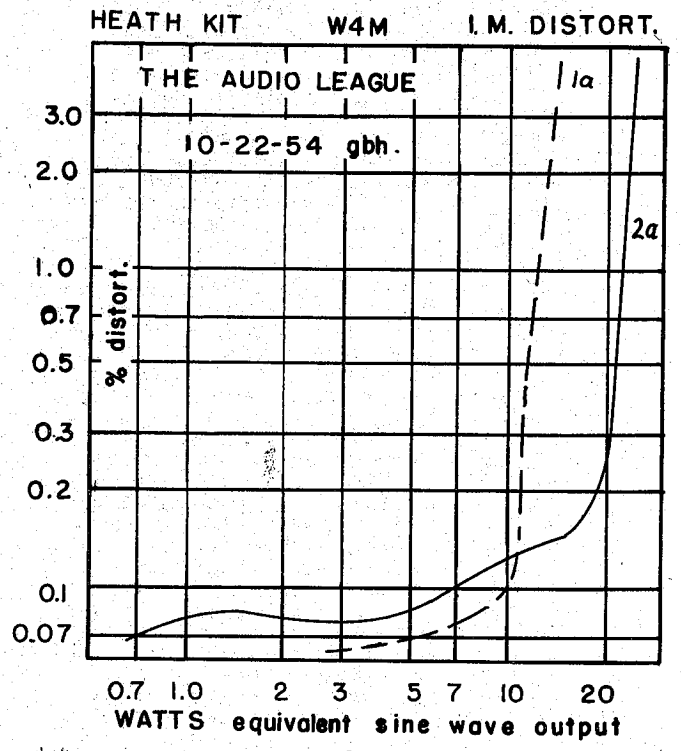
Cont. from pg. 4 Heathkit W4M



have encountered under home listening conditions. At its low price of $39.75, it is an outstanding "best buy". We do not feel that the two-chassis Heathkit amplifier, bargains though they are, are worth the $10. price differential unless their physical dimensions make installation simpler.

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TEST REPORT ON THE FISHER 70RT TUNER

The Fisher 70RT is an AM-FM tuner with a built-in preamplifier. The tuner portion of the set is identical to the Model 50R, which does not include the preamplifier. The 70RT sells for $184.50, the 50R for twenty dollars less.

Physically, the 70RT is attractively packaged, looking fairly similar to most competitive units when viewed from the front. Underneath, it appears to be more neatly laid out and wired than other competitive units we have been, such as the Craftsmen C-800. A bottom plate is provided, as on all Fisher components.

On one of the sets we tested, the dial assembly frame was welded on its brackets improperly, cocking it at an angle which made it impossible to mount the tuner flush with a wooden panel. We were able to correct this condition ourselves, though Fisher undoubtedly would have straightened out the difficulty, had the set been returned to them.

On the front panel are six controls: bass tone control (including line switch), treble tone control, loudness-volume control (concentrically mounted), channel and equalization selector switch, tuning.

On the back are sockets for AM and FM antennas (both provided--the latter a twin lead folded dipole which is quite adequate in most locations), input connectors for phono cartridge and TV sound, two output connectors, two auxiliary power outlets, a fuse holder and a control for adjusting the AFC action. These will be discussed in more detail later in this report.

We will consider the tuner and preamplifier portions of the 70RT separately. The tuner was tested in accordance with the procedure outlined elsewhere in this issue; the preamplifier tests were as described in last month's issue of the Audio League Report

Two units were tested for FM tuner performance. AM performance was not measured, though some listening was done. The reasons for this omission were several: a high quality signal generator with accurately calibrated attenuator and frequency control for sensitivity and bandwidth measurements was not available, and we feel that AM reception in general is not compatible with what we consider high fidelity performance. Our listening tests, however, including comparisons of the AM and FM programs from the same station in several cases, showed that the 70RT AM section is distinctly better than average in sensitivity and frequency response. Nevertheless, the caliber of sound obtained on AM, even on the strongest local stations, was not comparable to that derived from their FM outlets.

The FM sensitivities of both units were substantially identical. On the 300-ohm inputs, the sensitivity for 20db quieting varied from 5 microvolts at 88mc to 6.5 microvolts at 108 mc. These are "hard" microvolts (see discussion of tuner sensitivity measurements). Fisher's claimed sensitivity is 3 microvolts for 20 db quieting, which might lead us to suspect that they are using "soft" microvolts. This results in a much more attractive advertising claim, of course, and there would be little objection to this practice, from a practical standpoint, if everyone used this method of measurement. However, the correct method of measuring receiver sensitivity, the I.R.E. standard method, gives figures about twice as large as the other method, thereby placing the manufacturer using it under a handicap unless he is careful to explain in his ad how he arrives at his claimed performance. (National for instance.)

Thus, if we assume that Fisher used "soft" microvolts in their ratings, their claims are justified--even a little on the conservative side. Since their sensitivity figures were (?) based on the IRE standard measuring technique, our test units were about 6db below claimed performance. This is actually a very small discrepancy, since normal variations in tubes can easily produce such a sensitivity difference.

For the benefit of those of our readers who find these technic[illegible]tters confusing--the 70RT is a mighty sensitive tuner indeed! Pleasantville is 35 miles from New York City, yet with the folded dipole antenna supplied with the tuner draped over a bench on the first floor of a steel framed concrete building, we received fifteen stations during mid-day with fully quieting signal strength. Other tuners we have tried under similar conditions have pulled in from 5 to 11 stations. To date, the 70RT is the most sensitive FM tuner we have tested. (We have not yet tried the National Criterion or Craftsmen C-900, both of which are claimed to be really "hot.")

Another important test is that of IF and discriminator bandwidth. An FM station may deviate ±75kc on peaks, requiring at least 150kc bandwidth in the receiver, through the discriminator output, if distortion is to be avoided. Since the station's carrier may not

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THE AIR COUPLER

The so-called "Air Coupler" was introduced to the high-fidelity world over four years ago, in an article appearing in FM-TV magazine for October 1950. It was heralded as part of the "FAS" Audio System...a new method of audio reproduction".

It seems that the late Edmund Flewelling, a pioneer of radio's early days, had developed an amazing system of sound reproduction which produced unbelievable bass response with no visable sign of the large speaker enclosure usually considered necessary for such performance. Messrs. Fowler and Allison of the FM-TV staff (now of High Fidelity magazine) visited Mr. Flewelling, listened, and were duly impressed. Their article stated that the vibration in the floor from deep pedal organ notes felt as though 150 watts or more was behind. In fact, much less power was used.

Unfortunately, Mr. Flewelling's numerous eccentricities prevented publication of a paper by him, but the Fowler-Allison-Sleeper group undertook to improve the design and introduced it to the market. They used their initials so as to retain the FAS associated with the Flewelling Audio System.

The system consisted of one 6L6 pentode amplifier and a three-way crossover network with 350 and 1000-cycle crossover frequencies. Two of the three speakers were a horn-loaded tweeter for above 1000 cycles and a small box barely large enough for an Altec 600B 12" speaker for the middle range. The unusual part of the system was the Air Coupler which took over at 350 cycles and lower. The lower limit has been claimed to be 20 or even 16 cycles.

The "Air Coupler" was a coffin-like box, approximately 16" wide, 6" deep, and 6' long. A 600B speaker was mounted on the outside near one end, facing inward. Almost opposite it was a port approximately 5" by 14". The overall effect was somewhat like an organ pipe, excited by the speaker blowing across the end.

The "Air Coupler" was constructed of 3/4" plywood, heavily braced, and it was declared that the whole thing should be firmly anchored to the floor or wall for best results. A neat way of concealing the monstrosity was to build it into the floor between the joists with a small hot air register to allow the thunderous bass to emerge into the room, to the mystification of all. Only in one's own home could this disguise be utilized!

The writer constructed an "Air Coupler" soon after the original article was published. The plans were followed exactly. A 12" heavy Jensen PM speaker was used. A large 175-cycle crossover was first tried, later a separate, Williamson amplifier, driven by a variable frequency crossover network, was used to drive the "Air Coupler". Three additional speakers in a corner horn assembly completed the system.

The Air Coupler was installed in various locations in the prescribed manner. A distance of 12 feet separated it from the corner.

How did it sound? Quite impressive. There was a rather annoying boominess on male voices and, on occasion, a low-frequency resonance made itself known. By and large, however, the bass response was improved since the old enclosure only responded to 55 cycles.

Pedal notes were indeed potent, quite capable of rattling the windows. When we listened to large orchestras, the sense of feeling was added to the bottom of the musical spectrum.

The downfall of the "Air Coupler" in our system began when we set it up in an acoustically-treated room, 25 by 35 by 15 feet in size, to compete with Klipschorns, Altec Theater sound systems, as well as several lesser-sized systems. The Air Coupler was an embarrassingly total failure. Hardly a groan emerged from it. Its ultimate disgrace came when the diminutive 8T8-1 Permoflux speaker in a Baronet enclosure, (a remarkable combination by the way, but that is another story), outclassed it on all types of material including organ music and Cook's "Rail Dynamics".

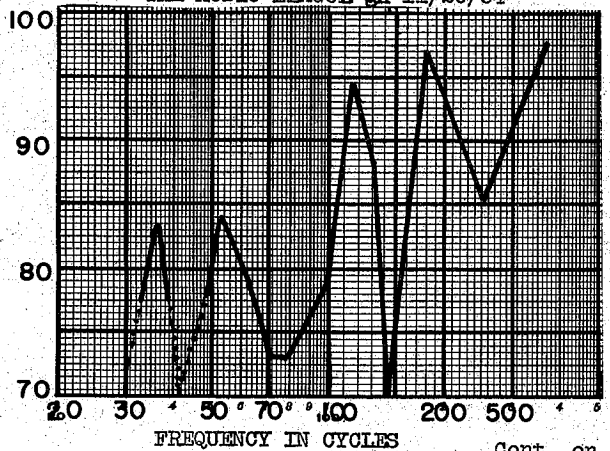
We thus concluded that the "Air Coupler" could produce some fairly solid bass in a small room, but of little use in a larger room. Basically, it is about as inefficient as an enclosure can be. There is little air loading on either side of the cone, thus its power capacity is limited. No wonder Flewelling used only a 5-watt amplifier!

In subsequent issues of FM-TV, the FAS group described a modification of the original consisting of partitions to add internal paths of different lengths. Their primary purpose was to extend the range and modify the resonant peaks. We tried these modifications, with no audible change being apparent. We did not try the other modifications that were published. Our optimum results were attained with the crossover set at 85 cycles and slope of 6 db per octave. Resonances above 100 cycles add a boominess to the sound if too high a crossover frequency is used.

With the formation of the Audio League, we decided a more detailed study of the Air Coupler would be required. A complete two-channel (bi-amplifier if you please) system was set up in a rather large room and prolonged listening and other tests were made. The sound was quite good with favorable audience reactions noted for the Air Coupler's part.

A check on the low end with an audio oscillator led to the disturbing discovery that below 50 cycles, the response fell off rapidly. In fact, at 42 cycles, no sounds could be obtained. A General Radio sound level meter was used to take readings. These are shown in Fig. 1. An oscilloscope was used to monitor the waveforms picked up by the sound level meter. At 42 cycles, only harmonics were observed. Lower frequencies improved until, at 36 cycles, an undistorted large output was obtained. At twenty feet it was 100 db- enough to be painful. Below 36 cycles the response fell rapidly with nothing remaining below 30 cycles.

Fig. 1.
FREQUENCY vs ACOUSTIC OUTPUT
FAS AIR COUPLER
THE AUDIO LEAGUE @ 11/26/54



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AIR COUPLER, cont. from pg. 6

So as to avoid some of the possible room resonance effects, the readings for fig. 1 were obtained outdoors. The Air Coupler was placed on its side with its back against a building facing a large open area. Six watts of pure tones were fed into the voice coil. This only produced an 80 db level at 100 cycles. A few tenths of a watt will produce this level with most other speaker enclosures. The limited power capacity of the "Air Coupler" prevents the proper use of equalization of the amplifier to overcome deficiencies of the frequency response.

These curves are in general agreement with those of Mr. Allison in his October 1951 FM-TV report. We did differ in the magnitude of the peak to valley ratio. He had 6 db, ours had 12 db. (We show by dotted lines the portion that had extreme distortion).

Mr. Allison's curves show substantial output down to 20 cycles. We found no trace of fundamentals below 30 cycles. Between 35 and 30 cycles the fundamental was present at very low levels (that small room again). Since his tests did not account for distortion, we must assume that ours are more valid.

The excessive distortion between 38 and 50 cycles is not shown on either curve. Thus the curve shows only a portion of the data.

We also applied a transient test using an ingenious method devised by G. A. Briggs of Wharfdale. A dry cell is used to apply a voltage to the voice coil. When it is disconnected momentarily, the speaker acts as a generator. The generated voltage (acting as a counter EMF during normal speaker operation) was viewed on an oscilloscope. A photograph of this transient appears in figure 2.

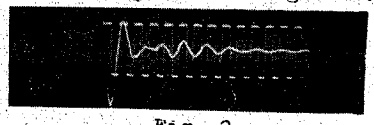

Fig. 2
Air Coupler Transient Response
superimposed on 60cps square waves

Mr. Briggs has found a direct correlation between the duration of the transient and the listening quality of the loudspeaker. The fewer the number of cycles of ringing, the better the sound. This criterion leads to the obvious conclusion that this enclosure is not very good.
Cont. on pg. 8.

FISHER 70RT TUNER, cont. from pg. 5

be centered in the receiver's pass band, as commonly occurs with AFC systems, and only too often with manually tuned receivers it is desirable to have considerably more bandwidth available. Also, the discriminator circuits all become non-linear near their frequency extremes, so a wider peak-to-peak separation will result in more linear response in the center portion of the characteristic where most of the signals will be located.

The Fisher instruction booklet, which is quite complete, by the way, shows a discriminator characteristic approximately 400 kc wide between peaks. It is actually necessary to define the combined response of the IF amplifier and the discriminator, which yields increasing bandwidths as signal strength is increased. This is the reason why some sets with too narrow IF bandwidth will sound alright on strong signals, yet be distorted on weaker signals. A set with adequately broad IF response will sound clear even at low signal levels, though the noise level will be higher, of course!

The measured overall bandwidth of the 70RT (one unit only tested for bandwidth) was 393 kc with a 100 microvolt input signal and 276 kc with a 10 microvolt input signal. These are adequate bandwidths, as evidenced by the undistorted output we got from some stations too weak to fully quiet the background noise.

The AFC control on the back of the set enabled any degree of AFC action from zero to maximum to be utilized. At its maximum setting, the AFC is quite strong, a station will hold in for a megacycle or so. Most of our staff preferred somewhat less AFC, but Fisher has enabled every user to suit himself.

The channel switch on the front panel, in addition to providing 4 record equalization characteristics, enables the user to select AM-Broad (14kc bandwidth), AM-Sharp (6kc bandwidth), FM without AFC, FM with AFC, and TV sound (via a connector on the rear of the set). Colored lights on the panel indicate which type of operation is selected.

Cont. in Issue 4, pg. 5 with a discussion of the tone controls and record equalizer.

"...could not have been better even if I were working on your staff..."
Paul Bernard, Stamford, Conn.

********** cut here **********

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Continued from Page 2. Tuner Testing

A Ballantine Model 310 vacuum-tube voltmeter is connected across the tuner output, after the de-emphasis network but before any tone controls if possible. If this is not possible, tone controls are adjusted for flattest response. The RMS noise output of the receiver is observed, and the signal generator output is increased until the noise level has been reduced by 20, 30, or 40 db, depending on the particular receiver and which degree of quieting the manufacturer has mentioned in his performance claims.

IF bandwidth is measured by reading the limiter rectified grid bias, which is proportional to the signal strength, and varying the signal generator frequency so as to cover the IF bandpass region, with AFC disabled. The signal generator is connected in the same manner as for sensitivity measurement. The points on the IF response where the voltage drops to half its maximum value (6 db down) are determined, the difference between them being the IF bandwidth.

Combined IF and discriminator bandwidth is measured by reading the DC voltage at the disciminator output. This voltage varies from zero at the center of the discriminator response (presumably the IF center frequency) to a maximum plus value at one discriminator peak and a maximum minus value at the other peak. We vary the generator frequency from one peak to the other, recording the difference in dial readings as combined IF--discriminator bandwidth. This bandwidth becomes larger as signal strength is increased, due to the limiting action compensating for the deficiencies in IF bandwidth, so we measure it at several signal levels.

Finally, a physical and listening appraisal covers such items as tuning ease, dial legibility, AFC effectiveness, hum or distortion in the output, excessive heating of power transformer or other components, etc..

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FOR THE FUTURE

Fisher Zmatic
Scott Tuner and Preamp
Brociner A-100 - CA2 Preamp
Craftsmen C900 Tuner
Cartridges - Audak, GE, Fairchild

AIR COUPLER, cont'd from pg. 7.

Summarizing, we feel that the Air Coupler gives an unusual amount of bass response for an enclosure of its volume -- that is, if it can be easily concealed, the room is quite small and organ music is your fare. These conditions present the possibility of it being a worthwhile addition to some systems. We recommend that a separate amplifier with the lowest possible crossover frequency be used.

Its response does not extend significantly below 35 cycles. In our experience many 12" speakers will do as well in less space such as the E-V Aristocrat, the Rebel, and other small enclosures. These enclosures will sound cleaner because they have better transient-handling characteristics.

The Air Coupler is the easiest enclosure to construct (no odd angles to require special tools). The addition of bass response is also assured for the poorly baffled small speaker. The source of sound is also well diffused.

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Appreciation

"Judging from the components tested and reported on in your first issue, I can only arrive at the conclusion that your organization is staffed by a group of incompetent impractical-minded crackpots....It is well-known that...the loudspeaker, and the phono-pickup, are the 'bottle-necks' and ...generate the greatest amount of distortion...also...that.. (there is)..no audible difference...between various amplifiers .....the quality of the audio reproduction is governed more by the speaker than by any other component in the system.....Instead...you incompetent crackpots...ignore the 'mountains' of distortion generated by speakers, and pickups, ... How wacky can you get?"

H. Skalamer, New York City

(Editor's Note: In over 200 responses to our first issue, this was the only letter received which was adverse. We really didn't think we could completely cover the whole audio field in our first issue - although we must admit we did fairly well in our second. Incidentally, this was one of 126 gift subscriptions received to date. We hope you will all give a really enjoyable present to your friends for Christmas, a subscription to the AUDIO LEAGUE REPORT. And we know that they'll surely appreciate it, as we believe Mr. Skalamer will.)

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